

- 2:00 *Numerical Cognition: What Changes in Older Adults?*
Dr. Patrick Lemaire, University de Province
- 2:30 BREAK
- 2:45 *Aging and Assessment of Covariation in Causal Learning*
Dr. Sharon Mutter, Western Kentucky University
- 3:15 *Affect and Deliberation as Dual Modes of Thinking in Decision Processes*
Dr. Ellen Peters, Decision Research
- 3:45 BREAK
- 4:00 *Quantitative Reasoning in Older Adults' Judgments and Decisions*
Dr. Reid Hastie, University of Chicago
- 4:30 Plenary Discussion – *Psychological Approaches to the Study of Quantitative Judgments and Decisions*
- 5:00 ADJOURN
- 6:30 Dinner – Jean-Michel Restaurant, Wildwood Shopping Center, Old Georgetown Road and Democracy Blvd. (By invitation only)

Tuesday, July 16, 2002

- A.M.** 8:00 CONTINENTAL BREAKFAST
- 8:30 *How Probabilistic Thinking Affects Economic Behavior*
Dr. Robert Willis, University of Michigan
- 9:00 *Rational and Irrational Choices in Retirement Planning*
Dr. David Laibson, Harvard University
- 9:30 Plenary Discussion – *Quantitative Reasoning and Economic Decisions*
- 10:15 BREAK
- 10:30 *Financial Abilities in Normal Older Adults and Patients With Alzheimer's Disease*
Dr. Daniel Marson, University of Alabama
- 11:00 Plenary Discussion – *Associated Topics (e.g., math anxiety, cognitive estimation, cultural factors)*
- 11:45 BREAK
- 12:00 Plenary Discussion -- *Future Directions*
- 12:30 Wrap-up/Closing Remarks – Dr. Richard Suzman, BSR/NIA
- P.M.** 1:00 ADJOURN

Quantitative Reasoning in Adult Development and Aging

BSR Exploratory Workshop, July 15-16, 2002

Quantitative literacy will become increasingly important for older adults as our society becomes progressively more reliant on numerical information for purposes of decision-making. As Steen (1997) has noted, "Literacy is no longer just a matter of words, sentences, and paragraphs, but also of data, measurements, graphs, and inferences." So-called "civic literacy" requires quantitative understandings in order to make sense of election polls, taxes, census data, and other societal indices. Similarly, a comparatively high level of numerical comprehension and reasoning is required for accurate interpretation of medical and scientific news, for wise investment and retirement decisions, and for making sound judgments about health-related matters. Indeed, as Sanfey and Hastie (2000) point out, "Many everyday judgment tasks involve reasoning from items of information to estimate a magnitude, quantity, or condition." These include tasks such as estimating how much the groceries will cost, determining the interest rate on a mortgage, or ascertaining what one's monthly income will be after retirement. Unfortunately, however, little is known about the maintenance or decline of quantitative reasoning skills in older adults. As such, an exploratory workshop entitled "Quantitative Reasoning in Adult Development and Aging" was held in Bethesda, MD, July 15-16, 2002, with the goal of educating NIA extramural staff on the topics of greatest promise for development in this area. Organized and sponsored by the Behavioral and Social Research Program and the Neuroscience and Neuropsychology of Aging Program of the National Institute on Aging (NIA), the meeting included participants with expertise across a wide range of relevant fields, including: numerical cognition, quantitative and document literacy, mathematics, judgment and decision-making, neuropsychology, and behavioral economics. Attendees included program staff from the NIA and several other Institutes.

Outline of individual presentations

Session I

Workshop Overview
Dr. Daniel Berch, NIA

Three Score and Ten: Quantitative Needs of Older Adults
Dr. Lynn Arthur Steen, St. Olaf College

Quantitative and Document Literacy Skills: Distribution and Connection to Societal Outcomes
Dr. Irwin Kirsch, Educational Testing Service

Assessing Quantitative Reasoning in Household Surveys: A Comparison of New Measures in the HRS (US) and ELSA (UK)
Dr. David Weir, University of Michigan and Dr. Felicia Huppert, University of Cambridge

Low Numeracy and Literacy Skills Are Associated With Poor Anticoagulation Control
Dr. Carlos Estrada, East Carolina University

Plenary Discussion – *Measures of Numeracy/Quantitative Literacy*

Session II

Numerical Cognition: What Changes in Older Adults?
Dr. Patrick Lemaire, University de Province

Aging and Assessment of Covariation in Causal Learning
Dr. Sharon Mutter, Western Kentucky University

Affect and Deliberation as Dual Modes of Thinking in Decision Processes
Dr. Ellen Peters, Decision Research

Quantitative Reasoning in Older Adults' Judgments and Decisions
Dr. Reid Hastie, University of Chicago

Plenary Discussion – *Psychological Approaches to the Study of Quantitative Judgments and Decisions*

Session III

How Probabilistic Thinking Affects Economic Behavior
Dr. Robert Willis, University of Michigan

Rational and Irrational Choices in Retirement Planning
Dr. David Laibson, Harvard University

Plenary Discussion – *Quantitative Reasoning and Economic Decisions*

Session IV

*Financial Abilities in Normal Older Adults and Patients
With Alzheimer's Disease*
Dr. Daniel Marson, University of Alabama

Plenary Discussion – *Associated Topics (e.g., math anxiety, cognitive estimation, cultural factors)*

Session V

Plenary Discussion -- *Future Directions*

Wrap-up/Closing Remarks
Dr. Richard Suzman, BSR/NIA

Questions Posed to Participants

In order to gather additional information from the participants concerning the study of quantitative reasoning, they were asked to provide written answers to a series of questions posed by the NIA:

1. Increasingly more information in the newspapers and other media is being presented in graphical formats (e.g., medical and scientific news). However, there is some evidence of age-related declines in both quantitative and document literacy, which could of course compromise the ability of older adults to interpret information that may be crucial for their physical health, as well as for their psychological and financial well-being. Nevertheless, little is known about the mechanisms underlying these declines. What kinds of research approaches are needed to clarify the factors contributing to the decreases in these crucial skills? Should the NIA attempt to support research in this domain?
2. What kinds of quantitative reasoning skills are most important for cognitively demanding, instrumental activities of daily living (e.g., financial management, meal preparation, medication management, transportation, etc.)? Which, if any, of these would you consider to be fundamental to most if not all such activities?
3. How crucial is the role of conceptual models in advancing research in quantitative reasoning skills in adult development and aging? Are current models (psychological or economic) sufficiently well developed to be of heuristic value in this area?
4. To what extent do various existing measures of numeracy skills, numerical/arithmetic computation and comprehension skills, probabilistic reasoning, etc., satisfy rigorous psychometric criteria? What kinds of new measures are needed to advance research in this general area?
5. Several dimensions of numeracy or quantitative literacy have been articulated, including: a) *practical* -- for immediate use in the routine tasks of life; b) *civic* -- for understanding major public policy issues (e.g., making sense of election polls, taxes, census data, and other societal indices); c)

professional -- providing skills necessary for employment; and d) *recreational* -- to appreciate games, sports, etc. (Steen, L. A., 1990, Daedalus, 211-231). What are the most crucial research needs in any or all of these areas?

6. Dossey (1997, in L. A. Steen (Ed.), Why numbers count) has identified six important aspects of mathematics falling under the rubric of quantitative literacy, including data representation, numbers and operations, variables and relations, measurement skills, space and visualization, and chance. Are measurement and spatial visualizations skills understudied in adult development and aging? If so, of what importance do you think these are for successful performance in work- or leisure-related settings?
7. As Sanfey and Hastie (2000) point out, many everyday judgment tasks involve reasoning from items of information to estimate magnitudes or quantities. These include tasks such as estimating how much the groceries will cost, determining the interest rate on a mortgage, or ascertaining what one's monthly income will be after retirement. What are the best existing measures of estimation skills? What kinds of theoretical and/or methodological advances are needed to move this area forward?
8. Economists generally believe that probabilistic reasoning skills are crucial for making a variety of important decisions concerning financial management and planning. What kinds of advances are needed in measurement and methodology in order to further the progress in this area of research? Although psychologists are also interested in this topic, there seems to be little in the way of cross-fertilization of theoretical conceptions, research methods, measures, etc. What can the NIA do to help foster collaborative efforts that might yield novel, integrative approaches?
9. The contributions of culture and ethnicity to various facets of cognition are of increasing interest to both researchers and the NIA. Is there any reason to suspect that these factors may influence quantitative reasoning skills in older adults? If so, what steps need to be taken in order to facilitate the efficacious design and development of measures that would be appropriate for investigating such issues?
10. Math anxiety is usually defined as a feeling of tension, apprehension, or fear that interferes with math performance. It has been considered by some to constitute a genuine phobia, as it appears to meet the requisite, standard diagnostic criteria for this classification (e.g., a learned fear, situation-specific, accompanied by physiological reactivity, etc., Ashcraft, Mathematical Cognition, 1995, 1, 3-34). In addition, recent evidence suggests that in college students, math anxiety slows down and degrades the accuracy of on-line performance in math-related tasks by briefly disrupting working memory (Ashcraft & Kirk, 2001, JEP: General, 130, 224-237). Is there any reason to suspect that the prevalence of math anxiety in older adults is equal to or greater than that of younger adults? If so, is research in this area worthy of support by the NIA?
11. Is enough known about any particular domain of quantitative reasoning that it may be ripe for translational or intervention research? If so, please describe.

NIA program staff are currently synthesizing the responses to these questions, which when compiled will be reviewed along with the ideas generated from the presentations and plenary discussions to decide the next steps that should be taken in developing an initiative in the area of quantitative reasoning.

THE NATIONAL INSTITUTE ON AGING
QUANTITATIVE REASONING WORKSHOP
July 15-16, 2002
Participant List

Invited Speakers

Carlos Alberto Estrada, M.D.

East Carolina State University
The Brody School of Medicine
600 Moyer Boulevard
PCMH TA-389
Greenville, NC 27834
Tel: (252) 816-4633
Fax: (252) 816-4688
ESTRADAC@mail.ecu.edu

Reid Hastie, Ph.D.

Graduate School of Business - Center for
Decision Research
1101 E. 58th Street
University of Chicago
Chicago IL 60637
Tel: (773) 834-9167
Fax: (773) 702-0458
reid.hastie@gsb.uchicago.edu

Felicia Huppert, Ph.D.

University of Cambridge
Department of Psychiatry
Box 189 Addenbrooke's Hospital
Cambridge, CB2 2QQ
United Kingdom
Tel: 44 1223 336970
Fax: 44 1223 336968
fah2@cam.ac.uk

Irwin Kirsch, Ph.D.

Educational Testing Service
MS 02-R
Rosedale Road
Princeton, NJ 08541
Tel: (609) 734-1516
Fax: (609) 734-1309
ikirsch@ets.org

Patrick Lemaire, Ph.D.

Membre de l'Institut Universitaire de
France
LPC-CNRS & Universite de Provence
3 Place Victor Hugo

13331 Marseille

France

Tel: 33 4 91 10 62 24

Fax: 33 4 91 10 62 55

lemaire@newsup.univ-mrs.fr

Daniel Marson, J.D., Ph.D.

University of Alabama at Birmingham
JT 1216
625 South 19th Street
Birmingham, AL 35233-7340
Tel: (205) 934-2334
Fax: (205) 975-3094
dmarson@uab.edu

Sharon Mutter, Ph.D.

Department of Psychology
Western Kentucky University
1 Big Red Way
Bowling Green, KY 42101
Tel: (270) 745-4389
Fax: (270) 745-6934
sharon.mutter@wku.edu

Ellen Peters, Ph.D.

Decision Research
1201 Oak Street
Eugene, OR 97401
Tel: (541) 485-2400
Fax: (541) 485-2403
empeters@oregon.uoregon.edu

David Laibson, Ph.D.

Harvard University
Department of Economics
Littauer M-14
Cambridge, MA 02138
Tel: (617) 496-3402
Fax: (617) 495-8570
dlaibson@harvard.edu

Lynn Arthur Steen, Ph.D.

St. Olaf College
1520 St. Olaf Avenue
Northfield, MN 55057-1098
Tel: (507) 646-3412
Fax: (507) 646-3968
steen@stolaf.edu

David Weir, Ph.D.

Health & Retirement Study
Institute for Social Research
University of Michigan
426 Thompson Street
Ann Arbor, MI 48104-2321
Tel: (734) 936-0314
Fax: (734) 647-4575
dweir@umich.edu

Robert Willis, Ph.D.

Institute for Social Research
University of Michigan
426 Thompson Street
Ann Arbor, MI 48104
Tel: (734) 936-7261
Fax: (734) 647-1186
rjwillis@isr.umich.edu

NIA Staff

Robin Barr, Ph.D.

Office of Extramural Activities
7201 Wisconsin Avenue, Room 2C218
Bethesda, MD 20892-9205
Tel: (301) 496-9322
Fax: (301) 402-2945
BarrR@nia.nih.gov

Daniel Berch, Ph.D.

Behavioral and Social Research Program
National Institute on Aging
7201 Wisconsin Ave., Suite 533
Bethesda, MD 20892-9205
Tel: (301) 594-5942
Fax: (301) 402-0051
berchd@nia.nih.gov

Vicky Cahan

Communications & Public Liaison
National Institute on Aging
Bldg. 31, Room 5C25
Bethesda, MD 20892-2292
Tel: (301) 496-1752
cahanv@nia.nih.gov

Claudia Feldman

Communications & Public Liaison
National Institute on Aging
Bldg. 31, Room 5C25
Bethesda, MD 20892-2292
Tel: (301) 496-1752
feldmanc@nia.nih.gov

Jennifer Harris, Ph.D.

Behavioral and Social Research Program
National Institute on Aging
7201 Wisconsin Ave., Suite 533
Bethesda, MD 20892-9205
Tel: (301) 496-3138
Fax: (301) 402-0051
harrisje@nia.nih.gov

Kathy Mann Koepke, Ph.D.

Behavioral and Social Research Program
National Institute on Aging
7201 Wisconsin Ave., Suite 533
Bethesda, MD 20892-9205
Tel: (301) 402-4156
Fax: (301) 402-0051
koepkek@nia.nih.gov

Lenore Launer, Ph.D.

Laboratory of Epidemiology,
Demography, & Biometry
7201 Wisconsin Avenue, Suite 3C309
Bethesda, MD 20892-2292
Tel: (301) 496-1178
Fax: (301) 496-4006
launerl@nia.nih.gov

Georgeanne Patmios

Behavioral and Social Research Program
National Institute on Aging
7201 Wisconsin Ave., Suite 533
Bethesda, MD 20892-9205
Tel: (301) 594-5942
Fax: (301) 402-0051
PatmiosG@nia.nih.gov

Judith Salerno, M.D.

Office of the Director
National Institute on Aging
9000 Rockville Pike, Bldg. 31
Bethesda, MD, 20892
Tel: (301) 496-0216
salernoj@nia.nih.gov

Laura Shrestha, Ph.D.

Behavioral and Social Research Program
National Institute on Aging
7201 Wisconsin Ave., Suite 533
Bethesda, MD 20892-9205
Tel: (301) 496-3131
Fax: (301) 402-0051
shreshtl@nia.nih.gov

Sidney M. Stahl, Ph.D.

Behavioral and Social Research Program
National Institute on Aging
7201 Wisconsin Ave., Suite 533
Bethesda, MD 20892-9205
Tel: (301) 402-4156
Fax: (301) 402-0051
Sidney_Stahl@nih.gov

Richard Suzman, Ph.D.

Behavioral and Social Research Program
National Institute on Aging
7201 Wisconsin Ave., Suite 533
Bethesda, MD 20892-9205
Tel: (301) 496-3131
Fax: (301) 402-0051
suzman@nih.gov

Molly Wagster, Ph.D.

Neuroscience and Neuropsychology of
Aging Program
National Institute on Aging
7201 Wisconsin Ave., Suite 3C307
Bethesda, MD, 20892
Tel: (301) 496-9350
Fax: (301) 496-1494
wagsterm@nia.nih.gov

Other NIH Staff

Ronald Abeles, Ph.D.

Office of Behavioral and Social Sciences
Research, NIH
7201 Wisconsin Avenue, Suite 2C324
Bethesda, MD 20892-9205
Tel: (301) 496-7859
Fax: (301) 435-8779
abelesr@od.nih.gov

Margaret Feerick, Ph.D.

Child Development and Behavior
Branch
National Institute of Child Health and
Human Development
6100 Executive Boulevard, Room 4B05
Bethesda, MD 20892-7510
Tel: (301) 435-6882
Fax: (301) 480-7773

feerickm@mail.nih.gov

Carolyn Morf, Ph.D.

Behavioral Science Research Branch
Division of Neuroscience and Basic
Behavioral Science
National Institute of Mental Health
6001 Executive Blvd., Room 7216,
Bethesda, MD 20892-9651
Tel: (301) 443-3942
Fax: (301) 443-9876
cmorf@mail.nih.gov

James Schuttinga, Ph.D.

OSP, OD, National Institutes of Health
Building 1, Room 218, MSC 0166
9000 Rockville Pike
Bethesda, MD 20892
Phone: (301) 496-2229
Fax: (301) 402-0280
Email: js41z@nih.gov

Other Attendees

Teresa Seeman, Ph.D

School of Medicine
University of California, Los Angeles
10945 Le Conte Ave.
Division of Geriatrics/STE 2339
Los Angeles, CA 90095-1687
Tel: (310) 825-8253
Fax: (310) 794-2199
tseeman@medl.medsch.ucla.edu

